A Prospective Study of Depression Following Combat Deployment in Support of the Wars in Iraq and Afghanistan

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Report No. 08-05

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A Prospective Study of Depression Following Combat Deployment in Support of the Wars in Iraq and Afghanistan

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Objective. We investigated relations between deployment and new-onset depression among US service members recently deployed to the wars in Iraq and Afghanistan.

Methods. We included 40219 Millennium Cohort Study participants who completed baseline and follow-up questionnaires and met inclusion criteria. Participants were identified with depression if they met the Primary Care Evaluation of Mental Disorders Patient Health Questionnaire criteria for depression at follow-up, but not at baseline.

Results. Deployed men and women with combat exposures had the highest onset of depression, followed by those not deployed and those deployed without combat exposures. Combat-deployed men and women were at increased risk for new-onset depression compared with nondeployed men and women (men: adjusted odds ratio [AOR]=1.32; 95% confidence interval [CI]=1.13, 1.54; women: AOR=2.13; 95% CI=1.70, 2.65). Conversely, deployment without combat exposures led to decreased risk for new-onset depression compared with those who did not deploy (men: AOR=0.66; 95% CI=0.53, 0.83; women: AOR=0.65; 95% CI=0.47, 0.89).

Conclusions. Deployment with combat exposures is a risk factor for new-onset depression among US service members. Post-deployment screening may be beneficial for US service members exposed to combat. (*Am J Public Health.* 2010;100:90–99. doi:10.2105/AJPH.2008.155432)

Depression is one of the most prevalent and costly of all public health problems.[1,2] Estimates of the 12-month and lifetime prevalence for *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition* (*DSM-IV*)[3] major depressive disorders is 5.3% to 6.6% and 13.2% to 16.2%, respectively.[4,5] Much of the burden associated with depression results from comorbidities and reduced ability to maintain employment. Estimates predict that by 2020 depression will be second only to ischemic heart disease as a cause of disability.[6] Even those with minor depression have higher levels of impairment based on measures of functional status and social health, and incur higher rates of medical services utilization.[7]

Female gender and heredity are reported risk factors for depression.[4,8] Women are twice as likely to be diagnosed with depression as men, which may be the result of differences in biological vulnerabilities and environmental experiences.[9] Individuals experiencing threats to personal safety, such as living in unsafe neighborhoods, and individuals living close to the World Trade Center following the events of September 11, 2001, were found to be at increased risk for depression.[10,11]

Deployments pose unique and often stressful situations to military personnel. Although the association between deployment and posttraumatic stress disorder (PTSD) has been investigated,[12–20] little is known regarding the risk for depression. One cross-sectional survey that utilized previously studied UK veterans at high risk for mental disorders found depression more common than posttraumatic stress disorder.[21] Another cross-sectional study utilizing National Comorbidity Survey data found an increased risk for major depressive disorders among male participants with combat experience.[22] These findings are supported by other population-based studies that observed an increased risk for mental disorders among 1991 Gulf War veterans,[23,24] and 1991 Gulf War or Bosnia veterans[25]; however, none were of longitudinal design.

More recently, members of the US Army and US Marine Corps were at increased risk for depression upon return from combat duties in Afghanistan and Iraq, compared with soldiers who completed questionnaires within 1 week prior to deployment.[13] However, questionnaires were administered anonymously, making it difficult to identify new-onset depression upon return from deployment. Similarly, a cross-sectional survey of Canadian Forces identified significant associations between depression and exposure to combat or atrocities.[26] Finally, depression following deployment may be comorbid with PTSD[27] and other mental disorders.[25]

Per Department of Defense policy, all members are screened for mental disorders before deployment.[28,29] Screening includes a review of medical records and an interview with a credentialed provider. Diagnosis or symptoms of depression and PTSD must be assessed for deployment suitability. Disqualifying mental health conditions include, among others, bipolar disorder and psychotic disorders, and disqualifying medications include, but are not limited to, lithium, antipsychotics, and anticonvulsants. Also, those with changes in mental disorder treatment with less than 3 months of stability, or other concerns regarding fitness for duty while deployed, are disqualified.

The Millennium Cohort is the largest-ever population-based prospective study of a military population designed to improve the scientific knowledge of the long-term health effects associated with military service.[30] Between 2001 and 2008, 3 panels of US service members were enrolled into the study. Baseline enrollment for the 3 panels ended with 31% of those invited consenting to participate in the 21-year study. The first enrollment cycle was conducted between July 2001 and June 2003, with

TABLE 1—Demographic Characteristics of Participants (N = 40 219), by Deployment Status: Millennium Cohort Study, 2001–2006

Baseline Characteristic	Men (n = 30 041)			Women (n = 10 178)		
	Not Deployed (n = 22 126), No. (%)	Deployed Without Combat Exposures (n = 3940), No. (%)	Deployed With Combat Exposures (n = 3975), No. (%)	Not Deployed (n = 8543), No. (%)	Deployed Without Combat Exposures (n = 891), No. (%)	Deployed With Combat Exposures (n = 744), No. (%)
Birth year						
Pre-1960	6 599 (29.8)	854 (21.7)	634 (16.0)	2073 (24.3)	100 (11.2)	95 (12.8)
1960–1969	9 371 (42.4)	1813 (46.0)	1663 (41.8)	3147 (36.8)	323 (36.3)	249 (33.5)
1970–1979	5 687 (25.7)	1156 (29.3)	1494 (37.6)	2785 (32.6)	370 (41.5)	321 (43.2)
1980–present	469 (2.1)	117 (3.0)	184 (4.6)	538 (6.3)	98 (11.0)	79 (10.6)
Education						
High school or less	9 342 (42.2)	1309 (33.2)	2025 (50.9)	3532 (41.3)	372 (41.8)	388 (52.2)
Some college	5 597 (25.3)	1517 (38.5)	801 (20.2)	2132 (24.9)	308 (34.6)	134 (18.0)
College degree	7 187 (32.5)	1114 (28.3)	1149 (28.9)	2880 (33.7)	211 (23.7)	222 (29.8)
Marital status						
Never married	4 505 (20.4)	834 (21.2)	1066 (26.8)	3024 (35.4)	386 (43.3)	355 (47.7)
Married	16 546 (74.8)	2897 (73.5)	2727 (68.6)	4460 (52.2)	405 (45.5)	294 (39.5)
Divorced	1 075 (4.9)	209 (5.3)	182 (4.6)	1059 (12.4)	100 (11.2)	95 (12.8)
Race/ethnicity						
Non-Hispanic White	16 344 (73.9)	3021 (76.7)	2754 (69.3)	5391 (63.1)	544 (61.1)	429 (57.7)
Non-Hispanic Black	2 094 (9.5)	348 (8.8)	353 (8.9)	1736 (20.3)	193 (21.7)	145 (19.5)
Other	3 688 (16.7)	571 (14.5)	868 (21.8)	1416 (16.6)	154 (17.3)	170 (22.9)
Smoking						
Never smoker	13 156 (59.5)	2427 (61.6)	2333 (58.7)	5587 (65.4)	581 (65.2)	469 (63.0)
Past smoker	5 710 (25.8)	911 (23.1)	915 (23.0)	1861 (21.8)	174 (19.5)	152 (20.4)
Current smoker	3 260 (14.7)	602 (15.3)	727 (18.3)	1095 (12.8)	136 (15.3)	123 (16.5)
CAGE/alcohol[a]						
No	17 884 (80.8)	3197 (81.1)	3203 (80.6)	7595 (88.9)	787 (88.3)	651 (87.5)
Yes	4 242 (19.2)	743 (18.9)	772 (19.4)	948 (11.1)	104 (11.7)	93 (12.5)
Baseline PTSD[b]						
No	21 762 (98.4)	3903 (99.1)	3905 (98.2)	8380 (98.1)	884 (99.2)	732 (98.4)
Yes	364 (1.7)	37 (0.9)	70 (1.8)	163 (1.9)	7 (0.8)	12 (1.6)
Military rank						
Enlisted	15 674 (70.8)	2899 (73.6)	2805 (70.6)	5977 (70.0)	715 (80.3)	536 (72.0)
Officer	6 452 (29.2)	1041 (26.4)	1170 (29.4)	2566 (30.0)	176 (19.8)	208 (28.0)
Service component						
Reserve/National Guard	10 057 (45.5)	1561 (39.6)	1456 (36.6)	4401 (51.5)	366 (41.1)	351 (47.2)
Active duty	12 069 (54.6)	2379 (60.4)	2519 (63.4)	4142 (48.5)	525 (58.9)	393 (52.8)
Branch of service						
US Army	10 321 (46.7)	948 (24.1)	2539 (63.9)	4262 (49.9)	342 (38.4)	516 (69.4)
US Air Force	6 113 (27.6)	2125 (53.9)	849 (21.4)	2475 (29.0)	399 (44.8)	153 (20.6)
US Navy/Coast Guard	4 597 (20.8)	720 (18.3)	284 (7.1)	1625 (19.0)	139 (15.6)	65 (8.7)
US Marine Corps	1 095 (5.0)	147 (3.7)	303 (7.6)	181 (2.1)	11 (1.2)	10 (1.3)
Occupational category						
Combat specialists	5 496 (24.8)	927 (23.5)	1301 (32.7)	491 (5.8)	83 (9.3)	65 (8.7)
Health care specialists	1 705 (7.7)	120 (3.1)	311 (7.8)	2198 (25.7)	68 (7.6)	183 (24.6)
Service supply and functional	5 524 (25.0)	828 (21.0)	838 (21.1)	3706 (43.4)	418 (46.9)	261 (35.1)
Other occupations	9 401 (42.5)	2065 (52.4)	1525 (38.4)	2148 (25.1)	322 (36.1)	235 (31.6)

Continued

TABLE 1—*Continued*

Cumulative length of deployments[c]						
0 d	22 126 (100.0)	. . .	. . .	8543 (100.0)	. . .	. . .
1–180 d	. . .	2694 (68.4)	1670 (42.0)	. . .	567 (63.6)	345 (46.4)
181–270 d	. . .	757 (19.2)	932 (23.5)	. . .	165 (18.5)	157 (21.1)
≥271 d	. . .	489 (12.4)	1373 (34.5)	. . .	159 (17.9)	242 (32.5)

Note. PTSD = posttraumatic stress disorder. Deployed defined as at least 1 deployment in support of the wars in Iraq and Afghanistan between the baseline and follow-up questionnaire. Percentages are rounded and may not sum to 100.

[a]At baseline, participant self-reported ever feeling at least 1 of the following: (1) a need to cut back on drinking; (2) annoyed at anyone who suggested cutting back on drinking; (3) a need for an "eye-opener," or early morning drink; and (4) guilty about drinking.

[b]Self-reported a PTSD diagnosis or screened positive for PTSD symptoms at baseline.

[c]Number of total days deployed in support of the wars in Iraq and Afghanistan between the baseline and follow-up questionnaire.

more than 77 000 individuals completing either a postal or Internet questionnaire. Between 2004 and 2006, approximately 71% of the first panel members completed a follow-up questionnaire. Investigations of potential reporting biases showed no differential in health care utilization in the year prior to enrollment[31]; strong test–retest reliability[32]; reliable reporting of vaccinations,[33,34] occupations,[35] and deployments[36]; and minimal differences between participants choosing submission by Internet survey or paper submission.[37] Analyses of potential responder bias in ongoing follow-ups continue.

The Millennium Cohort questionnaire includes, among other questions, mental health measures based on 2 standardized scoring instruments: the Primary Care Evaluation of Mental Disorders Patient Health Questionnaire (PHQ)[38] and the Medical Outcomes Study Short Form 36-Item Health Survey for Veterans.[39] We used Millennium Cohort Study data to investigate the association of new-onset depression and deployment in support of the wars in Iraq and Afghanistan.

METHODS

The Millennium Cohort Study was launched in 2001 to collect and evaluate population-based data on behavioral and occupational risks related to military service that may be associated with poor health.[30,40] The first panel of invited Millennium Cohort Study participants was randomly selected from all US military personnel serving in October 2000. To ensure sufficient power to detect differences in smaller subgroups, those with previous deployment to Kosovo, Bosnia, or Southwest Asia; Reserve and National Guard members; and women were oversampled. Through a modified Dillman approach, 77 047 consenting participants enrolled in the first panel of the Millennium Cohort Study.[41] The methodology of the study has been described elsewhere in detail.[30] Of the 77 047 enrolled in this first panel, 55 021 (71.4%) completed the follow-up questionnaire between June 2004 and February 2006. Those completing the follow-up questionnaire were slightly more likely to be born in 1969 or earlier, married, more highly educated, officers, and non-Hispanic White compared with participants who completed the baseline survey.

The population for this study included participants in the first panel of Millennium Cohort Study who had complete demographic, behavioral, and military-specific data and who completed the baseline and follow-up questionnaires. We excluded participants from the final sample if, at baseline, they reported ever having a diagnosis for depression, met the criteria for mild or other depression, or reported taking medicine for anxiety, stress, or depression. We also excluded those completing the baseline questionnaire after deployment, completing either questionnaire while on deployment, or not answering questions on depression diagnosis or symptoms or use of medication for anxiety, stress, or depression.

The Defense Manpower Data Center provided demographic and military-specific data from electronic personnel files, including gender, birth date, highest education level, marital status, race/ethnicity, deployment experience, pay grade, service component (active duty or Reserve/National Guard), service branch (US Army, US Air Force, US Navy, US Coast Guard, or US Marine Corps), and military occupations. Race/ethnicity was classified by the Defense Manpower Data Center, and was incorporated into analyses because of differences in prevalence and incidence for depression by race/ethnicity.[42,43]

Depression Data

The PHQ, embedded in the Millennium Cohort questionnaire, provides a psychosocial assessment based on scores of several health concepts.[38,44,45] For this study, we used the PHQ to assess depression. Sensitivity and specificity have been reported as high for the PHQ-defined major depressive disorder (sensitivity = 0.93; specificity = 0.89).[46] Major depressive disorder, as measured by 9 items from the PHQ, corresponds to the depression diagnosis from the *DSM-IV*.[47] Participants used a 4-point Likert scale to rate the severity of each depressive symptom from "not at all" to "nearly every day" during the previous 2 weeks prior to questionnaire completion. For this investigation, we defined participants as having new-onset depression at follow-up if they met the following 2 criteria: (1) endorsed having a depressed mood or anhedonia and (2) responded "more than half the days" or "nearly every day" to at least 5 of the 9 items, where suicidal ideation was counted if present at all.[44]

Deployment Status

We considered participants who had completed a deployment in support of the wars in Iraq and Afghanistan between the baseline and follow-up questionnaires to be deployed. We further categorized deployment status on the basis of self-reported exposure to combat at follow-up. We classified participants as deployed with combat exposure if they reported at least one combat experience in the past 3 years, including witnessing death, trauma,

TABLE 2—Percentage of New-Onset Depression Among Male Participants, by Deployment Status: Millennium Cohort Study, 2001–2006

Baseline Characteristics	Not Deployed, No. (%)	Deployed Without Combat Exposures, No. (%)	Deployed With Combat Exposures, No. (%)
Total	872 (3.9)	92 (2.3)	225 (5.7)
Birth year			
Pre-1960	219 (3.3)	22 (2.6)	26 (4.1)
1960–1969	346 (3.7)	38 (2.1)	85 (5.1)
1970–1979	280 (4.9)	26 (2.3)	90 (6.0)
1980–present	27 (5.8)	6 (5.1)	24 (13.0)
Education			
High school or less	471 (5.0)	48 (3.7)	165 (8.2)
Some college	212 (3.8)	26 (1.7)	38 (4.7)
College degree	189 (2.6)	18 (1.6)	22 (1.9)
Marital status			
Never married	211 (4.7)	22 (2.6)	76 (7.1)
Married	610 (3.7)	63 (2.2)	136 (5.0)
Divorced	51 (4.7)	7 (3.4)	13 (7.1)
Race/ethnicity			
Non-Hispanic White	671 (4.1)	71 (2.4)	167 (6.1)
Non-Hispanic Black	85 (4.1)	6 (1.7)	22 (6.2)
Other	116 (3.2)	15 (2.6)	36 (4.2)
Smoking			
Never smoker	422 (3.2)	50 (2.1)	107 (4.6)
Past smoker	247 (4.3)	22 (2.4)	51 (5.6)
Current smoker	203 (6.2)	20 (3.3)	67 (9.2)
CAGE/alcohol[a]			
No	655 (3.7)	73 (2.3)	176 (5.5)
Yes	217 (5.1)	19 (2.6)	49 (6.4)
Baseline PTSD[b]			
No	809 (3.7)	87 (2.2)	209 (5.4)
Yes	63 (17.3)	5 (13.5)	16 (22.9)
Military rank			
Enlisted	730 (4.7)	73 (2.5)	199 (7.1)
Officer	142 (2.2)	19 (1.8)	26 (2.2)
Service component			
Reserve/National Guard	404 (4.0)	34 (2.2)	94 (6.5)
Active duty	468 (3.9)	58 (2.4)	131 (5.2)
Branch of service			
US Army	485 (4.7)	31 (3.3)	170 (6.7)
US Air Force	185 (3.0)	35 (1.7)	32 (3.8)
US Navy/Coast Guard	160 (3.5)	21 (2.9)	11 (3.9)
US Marine Corps	42 (3.8)	5 (3.4)	12 (4.0)
Occupational category			
Combat specialists	188 (3.4)	15 (1.6)	55 (4.2)
Health care specialists	81 (4.8)	4 (3.3)	18 (5.8)
Service supply and functional	233 (4.2)	24 (2.9)	50 (6.0)
Other occupations	370 (3.9)	49 (2.4)	102 (6.7)

Continued

prisoners of war, or refugees. We identified those who deployed and did not report any of these experiences in the past 3 years as deployed without combat exposure.

Posttraumatic Stress Disorder

The Millennium Cohort questionnaire includes the PTSD Checklist–Civilian Version, a 17-item self-report measure of PTSD symptoms.[48,49] Participants used a 5-point Likert scale (from 1=not at all to 5=extremely) to rate the severity of each intrusion, avoidance, and hyperarousal symptom during the past 30 days. Following standard procedures, we scored participants as having PTSD symptoms at baseline if they reported a moderate or higher level of at least 1 intrusion symptom, 3 avoidance symptoms, and 2 hyperarousal symptoms at baseline.[3] We defined participants as having a PTSD diagnosis at baseline if they reported ever having a diagnosis of PTSD from a health care professional.

Statistical Analysis

We completed a descriptive investigation to examine deployment status; demographic, behavioral, and occupational characteristics; and baseline PTSD symptoms or diagnosis with new-onset depression, stratified by gender. To calculate associations between deployment status and new-onset depression, we used multivariable logistic regression, adjusting for demographic, behavioral, and occupational variables, as well as baseline PTSD symptoms or diagnosis. We defined alcohol misuse by positive endorsement of 1 or more CAGE (cut down, annoyed, guilt, eye-opener) questions,[50] which is noted as "CAGE/alcohol" hereafter. Because of known associations between smoking and depression,[51,52] and smoking and deployment,[53] there were concerns these relations may interact. We investigated this by entering a first-order multiplicative interaction term of deployment by smoking status into the regression model. We performed regression diagnostics, including examining covariates for multicollinearity and goodness-of-fit tests. We conducted all data analyses with SAS version 9.1.3 (SAS Institute Inc, Cary, NC).

RESULTS

There were 55 021 Millennium Cohort participants who completed the 2001–2003 and

TABLE 2—*Continued*

Cumulative length of deployments[c]			
0 d	872 (3.9)	. . .	. . .
1–180 d	. . .	57 (2.1)	96 (5.8)
181–270 d	. . .	23 (3.0)	53 (5.7)
≥271 d	. . .	12 (2.5)	76 (5.5)

Note. PTSD = posttraumatic stress disorder. Deployed defined as at least 1 deployment in support of the wars in Iraq and Afghanistan between the baseline questionnaire and follow-up questionnaire.
[a]At baseline, participant self-reported ever feeling at least 1 of the following: (1) a need to cut back on drinking; (2) annoyed at anyone who suggested cutting back on drinking; (3) a need for an "eye-opener," or early morning drink; and (4) guilty about drinking.
[b]Self-reported a PTSD diagnosis or screened positive for PTSD symptoms at baseline.
[c]Number of total days deployed in support of the wars in Iraq and Afghanistan between the baseline and follow-up questionnaire.

2004–2006 questionnaires. We excluded individuals with indicators of depression at baseline (n=6537), who deployed prior to completing the 2001–2003 questionnaire (n=1853), who completed a questionnaire while deployed (n=2553), or who did not have complete data (n=3859), leaving 40 219 Cohort members for inclusion in this study. We conducted separate analyses for the 30 041 men and 10 178 women who met study criteria.

TABLE 3—Percentage of New-Onset Depression Among Female Participants, by Deployment Status: Millennium Cohort Study, 2001–2006

Baseline Characteristics	Not Deployed, No. (%)	Deployed Without Combat Exposures, No. (%)	Deployed With Combat Exposures, No. (%)
Total	654 (7.7)	45 (5.1)	117 (15.7)
Birth year			
Pre-1960	125 (6.0)	3 (3.0)	19 (20.0)
1960–1969	212 (6.7)	13 (4.0)	32 (12.9)
1970–1979	258 (9.3)	24 (6.5)	52 (16.2)
1980–present	59 (11.0)	5 (5.1)	14 (17.7)
Education			
High school or less	326 (9.2)	25 (6.7)	73 (18.8)
Some college	161 (7.6)	14 (4.6)	18 (13.4)
College degree	167 (5.8)	6 (2.8)	26 (11.7)
Marital status			
Never married	234 (7.7)	18 (4.7)	49 (13.8)
Married	327 (7.3)	22 (5.4)	54 (18.4)
Divorced	93 (8.8)	5 (5.0)	14 (14.7)
Race/ethnicity			
Non-Hispanic White	449 (8.3)	30 (5.5)	74 (17.3)
Non-Hispanic Black	108 (6.2)	9 (4.7)	26 (17.9)
Other	97 (6.9)	6 (3.9)	17 (10.0)
Smoking			
Never smoker	363 (6.5)	24 (4.1)	68 (14.5)
Past smoker	175 (9.4)	10 (5.8)	25 (16.5)
Current smoker	116 (10.6)	11 (8.1)	24 (19.5)

Continued

We categorized men and women as not deployed (22 126 men and 8543 women), deployed without combat exposures (3940 men and 891 women), or deployed with combat exposures (3975 men and 744 women). Study participants had, on average, completed the baseline survey 404.1 days prior to deployment (range=1 to 1402 days), and had completed the follow-up survey 349.4 days, on average, after returning from deployment (range=1 to 1366 days).

Compared with nondeployers, deployed men and women were proportionately more likely to be younger and serving on active duty (Table 1). Men and women deployed without combat exposures were proportionately more likely to have some college education, be in the US Air Force, and have occupations listed as "other" (i.e., all other occupations excluding combat, health care, service, supply, and functional specialists) compared with the other groups. Conversely, men and women deployed with combat exposures were proportionately more likely to have a high school education or less, be serving in the US Army, and to be combat specialists, compared with nondeployed men and women. Deployed women were more likely to have never been married compared with nondeployed women. In addition, deployed men and women who reported combat exposures were proportionately more likely to have been deployed 181 days or more compared with those deployed without combat exposures.

Men and women deployed with combat exposures had the highest occurrence of new-onset depression, (5.7% and 15.7%, respectively), followed by those not deployed (3.9% and 7.7%, respectively), whereas participants deployed without combat exposures exhibited the lowest occurrence (2.3% and 5.1%, respectively; Tables 2 and 3). This trend remained consistent when we assessed demographic, behavioral, and military-related characteristics for new-onset depression (Tables 2 and 3). Across all 3 groups, men with the highest percentages of new-onset depression were proportionately more likely to be born in 1980 or later, less educated, other than married, current smokers, enlisted, and serving in the US Marine Corps or US Army. Furthermore, they were more likely to positively endorse CAGE/alcohol questions and

TABLE 3—*Continued*

CAGE/alcohol[a]			
No	560 (7.4)	38 (4.8)	95 (14.6)
Yes	94 (9.9)	7 (6.7)	22 (23.7)
Baseline PTSD[b]			
No	615 (7.3)	44 (5.0)	114 (15.6)
Yes	39 (23.9)	1 (14.3)	3 (25.0)
Military rank			
Enlisted	517 (8.7)	43 (6.0)	98 (18.3)
Officer	137 (5.3)	2 (1.1)	19 (9.1)
Service component			
Reserve/National Guard	312 (7.1)	20 (5.5)	54 (15.4)
Active duty	342 (8.3)	25 (4.8)	63 (16.0)
Branch of service			
US Army	361 (8.5)	23 (6.7)	89 (17.3)
US Air Force	147 (5.9)	16 (4.0)	16 (10.5)
US Navy/Coast Guard	133 (8.2)	6 (4.3)	12 (18.5)
US Marine Corps	13 (7.2)	0 (0.0)	0 (0.0)
Occupational category			
Combat specialists	37 (7.5)	3 (3.6)	5 (7.7)
Health care specialists	158 (7.2)	5 (7.4)	18 (9.8)
Service supply and functional	281 (7.6)	18 (4.3)	59 (22.6)
Other occupations	178 (8.3)	19 (5.9)	35 (14.9)
Cumulative length of deployments[c]			
0 d	654 (7.7)	. . .	. . .
1–180 d	. . .	26 (4.6)	45 (13.0)
181–270 d	. . .	7 (4.2)	23 (14.7)
≥271 d	. . .	12 (7.6)	49 (20.3)

Note. PTSD = posttraumatic stress disorder. Deployed defined as at least 1 deployment in support of the wars in Iraq and Afghanistan between the baseline questionnaire and follow-up questionnaire.
[a]At baseline, participant self-reported ever feeling at least 1 of the following: (1) a need to cut back on drinking; (2) annoyed at anyone who suggested cutting back on drinking; (3) a need for an "eye-opener," or early morning drink; and (4) guilty about drinking.
[b]Self-reported a PTSD diagnosis or screened positive for PTSD symptoms at baseline.
[c]Number of total days deployed in support of the wars in Iraq and Afghanistan between the baseline and follow-up questionnaire.

have PTSD symptoms or diagnosis at baseline. Similar to men, women with the highest odds of new-onset depression across all 3 deployment categories included those who were more likely to be current smokers, positively endorse CAGE/alcohol questions, have PTSD symptoms or diagnosis at baseline, be enlisted, and have a high school education or less (Table 3).

After we adjusted for deployment status, birth year, education, marital status, race/ethnicity, smoking status, positive CAGE/alcohol question responses, baseline PTSD symptoms or diagnosis, rank, service component, service branch, and occupation, both men and women deployed with combat exposure were significantly more likely to develop new-onset depression than were those not deployed (odds ratio [OR]=1.32; 95% confidence interval [CI]=1.13, 1.54; and OR=2.13; 95% CI=1.70, 2.65, respectively; Table 4). In contrast, men and women deployed without combat exposures were less likely to develop new-onset depression than were those who did not deploy (OR=0.66; 95% CI=0.53, 0.83; and OR=0.65; 95% CI=0.47, 0.89, respectively). In the adjusted model, men and women who were past or current smokers, had PTSD symptoms or diagnosis at baseline, positively endorsed CAGE/alcohol questions, or were enlisted had higher odds for new-onset depression. Additionally, women with new-onset depression were more likely to be born in 1970 or later, married or divorced, non-Hispanic White, active duty, and in the US Army or US Navy/Coast Guard. Men who were born in 1980 or later, served in the US Army, and worked in health care, service supply, or functional occupations had higher odds for new-onset depression.

No interaction was observed between smoking status and deployment status, nor was there interaction between baseline PTSD symptoms or diagnosis and deployment as related to depression. Additionally, length of deployment was collinear with deployment status, and excluded from the main analysis. However, to assess the significance of deployment length, we conducted a subanalysis incorporating deployment length with data of those deployed to examine the association between deployment length and new-onset depression. In this analysis, deployment length was not statistically significant.

DISCUSSION

We used Millennium Cohort Study data to identify more than 30 000 male and 10 000 female US service members who were free of depression at baseline. To our knowledge, this is the first population-based longitudinal study with baseline data prior to deployment to report a temporal association between combat exposure among deployed US service members and new-onset depression compared with nondeployed peers. However, finding an increased risk for a mental disorder associated with combat exposure is not unique, as Smith et al. observed similar findings for PTSD with Millennium Cohort data.[14]

Other research, though cross-sectional in design, has found similar depression risk with exposure to combat or witnessing atrocities among members of the Canadian military.[26] Although PTSD was associated with increased length of deployment among Vietnam veterans[54] and UK veterans serving in Afghanistan or Iraq,[55] this trend was not found for depression in this study. Additionally, a large historical prospective study found an inverse association between mental health hospitalizations and US servicewomen who were members of the US

TABLE 4—Multivariable Logistic Regression Adjusted Odds Ratio (AOR) of Depression, by Gender: Millennium Cohort Study, 2001–2006

Baseline Characteristics	Men, AOR (95% CI)	Women, AOR (95% CI)
2001–2006 deployment status[a]		
No deployment (Ref)	1.00	1.00
Deployed without combat exposures	0.66 (0.53, 0.83)	0.65 (0.47, 0.89)
Deployed with combat exposures	1.32 (1.13, 1.54)	2.13 (1.70, 2.65)
Birth year		
Pre-1960 (Ref)	1.00	1.00
1960–1969	1.06 (0.90, 1.24)	1.00 (0.80, 1.24)
1970–1979	1.20 (0.99, 1.45)	1.39 (1.10, 1.76)
1980–present	1.56 (1.10, 2.21)	1.61 (1.13, 2.28)
Education		
High school or less (Ref)	1.00	1.00
Some college	0.90 (0.75, 1.07)	1.03 (0.84, 1.27)
College degree	0.85 (0.68, 1.07)	1.10 (0.85, 1.43)
Marital status		
Never married (Ref)	1.00	1.00
Married	0.99 (0.84, 1.17)	1.25 (1.05, 1.49)
Divorced	1.22 (0.92, 1.62)	1.49 (1.16, 1.92)
Race/ethnicity		
Non-Hispanic White (Ref)	1.00	1.00
Non-Hispanic Black	0.88 (0.72, 1.08)	0.73 (0.59, 0.90)
Other	0.84 (0.71, 1.01)	0.75 (0.60, 0.93)
Smoking		
Never smoker (Ref)	1.00	1.00
Past smoker	1.18 (1.02, 1.36)	1.30 (1.09, 1.55)
Current smoker	1.52 (1.31, 1.77)	1.35 (1.10, 1.66)
CAGE/alcohol[b]		
No (Ref)	1.00	1.00
Yes	1.19 (1.04, 1.37)	1.27 (1.03, 1.57)
Baseline PTSD[c]		
No (Ref)	1.00	1.00
Yes	4.29 (3.34, 5.50)	2.98 (2.07, 4.28)
Military rank		
Enlisted	1.67 (1.31, 2.11)	1.65 (1.26, 2.16)
Officer (Ref)	1.00	1.00
Service component		
Reserve/National Guard (Ref)	1.00	1.00
Active duty	1.01 (0.88, 1.15)	1.21 (1.03, 1.42)
Branch of service		
US Army	1.52 (1.27, 1.82)	1.64 (1.33, 2.01)
US Air Force (Ref)	1.00	1.00
US Navy/Coast Guard	1.13 (0.91, 1.40)	1.55 (1.21, 2.00)
US Marine Corps	1.11 (0.81, 1.52)	0.88 (0.48, 1.60)
Occupational category		
Combat specialists (Ref)	1.00	1.00
Health care specialists	1.52 (1.20, 1.93)	1.09 (0.77, 1.55)

Continued

Navy or US Marine Corps serving in combat support occupations.[56] These contrasting observations may be caused by underlying differences in PTSD and depression risk factors, or because the Vietnam study was conducted on a relatively small sample many years after the war's end, making it difficult to rule out misclassification of exposure or outcome.

In this study, deployed men and women without combat exposures were significantly less likely to develop depression than were nondeployed men and women. This finding may suggest that individuals who are healthier and at less risk for depression are more likely to deploy and, thus, mitigate stress-related effects of deployment[57–60] among men and women who do not face combat exposures. In other words, deployment with low probability of exposure to combat (or the effects of combat, such as being in the line of fire or handling casualties, prisoners, or treating the wounded) may not be significantly stressful to the majority of US service members.

Military hardiness, the context-specific adaptation of psychological hardiness,[61] has been observed to moderate the impact of deployment stressors on depression.[62] Military hardiness may also partially explain the observation that male combat specialists were at lower risk for depression than either health care specialists or men whose duties include service supply and functional support, after adjustment for a number of variables, including combat exposure. It is possible that combat specialists are more mentally prepared for deployment-related stresses either through training or selection factors for their positions. Medical personnel have significant exposure to the after effects of the trauma of combat but may not be as well-prepared to cope with the effects of this exposure because of different training or constitutional make-up. Another possibility is that the range and type of combat stressors medical personnel experience are fundamentally different in unmeasured ways than those experienced by combat specialists. Men working in service supply and functional-support occupations conduct convoy and other duties that randomly and frequently put them in dangerous situations, and similarly may not have the advantages of combat specialist training or constitution.

The reporting of baseline PTSD symptoms or diagnosis was associated with new-onset

TABLE 4—*Continued*

Service supply and functional	1.20 (1.01, 1.43)	1.09 (0.78, 1.54)
Other occupations	1.09 (0.93, 1.28)	1.04 (0.74, 1.47)

Notes. CI = confidence interval; PTSD = posttraumatic stress disorder. Odds ratios for men and women are adjusted for all variables listed.

[a]Deployment defined as at least 1 deployment in support of the wars in Iraq and Afghanistan between the baseline questionnaire and follow-up questionnaire. Combat exposure defined as reporting at least 1 combat-like exposure on the follow-up questionnaire.

[b]At baseline, participant self-reported ever feeling at least 1 of the following: (1) a need to cut back on drinking; (2) annoyed at anyone who suggested cutting back on drinking; (3) a need for an "eye-opener," or early morning drink; and (4) guilty about drinking.

[c]Self-reported a PTSD diagnosis or screened positive for PTSD symptoms at baseline.

depression in adjusted models for both female and male US service members. Finding comorbid PTSD and depression following exposure to traumatic events has received significant attention in the scientific literature.[63–68] However, the causes of this comorbidity remain poorly understood.

One study found that trauma variables known to be related to PTSD development, such as type and horror of the trauma, were also related to the occurrence of comorbid mental disorders, including depression, generalized anxiety disorder, and agoraphobia.[69] Similarly, depression was observed to develop with or without comorbid PTSD following exposure to a traumatic event.[66,70] Some believe that PTSD and depression comorbidity can be largely explained by common genetic influences.[71,72] Further research to unravel this comorbidity is paramount as comorbid PTSD and depression have been reported to increase dysfunction,[63,64] health care utilization,[65] and the risk for suicide.[65,68] Data from the Millennium Cohort Study have contributed to the understanding of PTSD among US military populations.[14,15,73] Following the publication of this article and as additional cohort data become available, subsequent analyses will investigate PTSD and depression comorbidity.

Other risk factors for depression observed in this study were consistent with previous reports that used data from military and civilian populations.[4,5,73–75] In adjusted models, male and female US service members were at increased risk for depression if they were younger, past or current smokers, positively endorsed CAGE/alcohol questions, and had served in the US Army. Additionally, women who were married or divorced, non-Hispanic White, active duty, and served in the US Navy/Coast Guard were at increased risk of depression. The increased risk of depression among married women compared with never-married women may be related to postpartum depression,[76] separation anxiety associated with leaving family members while deployed, or a lack of social support in the deployed setting. Although few studies have examined increased separation anxiety or increased lack of social support among deployed married women, animal studies provide evidence that separation may induce depression,[77,78] and studies have found an association between sense of belonging and depression.[79,80] It is also plausible that differences exist in role expectations and family or social support for married male and female deployed service members. For example, married women may be expected to resume routine family care while attempting to cope with the events of the deployment, more so than their male counterparts.

Limitations to these analyses should be noted. A population accounting for 31% of invited cohort members as well as self-report of exposures and symptoms has the potential to introduce bias. However, multiple investigations of possible reporting and selection biases in baseline Millennium Cohort data suggest reliable reporting, minimal response bias, and a representative sample of military personnel, including deployers.[14,15,30–35,37,73,81] Use of the PHQ along with the *DSM-IV* criteria has shown to correlate well with a physician's assessment of depression symptoms,[32] and the PHQ is internally valid in Millennium Cohort members.[32] However, the use of a standardized instrument for self-reported data as a surrogate for depression diagnosis is imperfect. Finally, the definition of combat exposure in this study was quite broad, encompassing a number of stressful events that often accompany combat, but do not necessarily indicate actual engagement in combat operations (i.e., exchanging fire with an enemy).

Despite limitations, these analyses offer the first large, prospective epidemiological investigation of new-onset depression symptoms in combat-deployed military men and women. The large sample of both men and women along with adjustment for multiple potential confounding variables allowed for a robust investigation of the association between deployment and new-onset depression. Depression is often underreported in electronic health care databases among populations that do not readily access care for mental disorders, making it often advantageous to use self-reported measures.

In summary, male and female US service members who deployed and reported combat exposures were at increased risk for depression compared with nondeployed service members, after adjustment for baseline PTSD symptoms or diagnosis and other potentially confounding variables. Conversely, men and women who deployed and did not report combat exposures were at lower risk for depression than nondeployed men and women. These findings support hypotheses that stress associated with combat may lead to depression, and that stress related to deployment, in the absence of combat exposure, may be mitigated by selective deployment of service members who are at decreased risk for the development of depression in comparison with nondeployed men and women. ■

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This article was accepted on April 12, 2009.

Contributors

T.S. Wells led the design, analyses, and article development. C.A. LeardMann contributed to the design, conducted

most of the analyses, and assisted with article writing. S. O. Fortuna assisted with design, made recommendations during the analyses, and wrote the introduction of the article. B. Smith, T. C. Smith, M. A. K. Ryan, E. J. Boyko, and D. Blazer made significant contributions to the design, helped to guide analyses, and provided critical review of the article.

Acknowledgments

This work represents report 08-06, supported by the Department of Defense, under work unit no. 60002. The views expressed in this article are those of the authors and do not reflect the official policy or position of the Department of the Navy, Department of the Army, Department of the Air Force, Department of Defense, Department of Veterans Affairs, or the US Government.

In addition to the authors, the Millennium Cohort Study Team includes Lacy Farnell, Gia Gumbs, Isabel Jacobson, Molly Kelton, Travis Leleu, Jamie McGrew, Katherine Snell, Steven Spiegel, Kari Welch, Martin White, James Whitmer, and Charlene Wong from the Department of Defense Center for Deployment Health Research, Naval Health Research Center, San Diego, CA; Paul J. Amoroso, from the Madigan Army Medical Center, Tacoma, WA; Gary D. Gackstetter, from the Department of Preventive Medicine and Biometrics, Uniformed Services University of the Health Sciences, Bethesda, MD, and Analytic Services Inc, Arlington, VA; Gregory C. Gray, from the College of Public Health, University of Iowa, Iowa City; Tomoko I. Hooper, from the Department of Preventive Medicine and Biometrics, Uniformed Services University of the Health Sciences; and James R. Riddle, from the US Air Force Research Laboratory, Wright-Patterson Air Force Base, OH. We are indebted to the Millennium Cohort Study participants, without whom these analyses would not be possible. We thank Scott L. Seggerman and Greg D. Boyd from the Management Information Division, Defense Manpower Data Center, Seaside, CA. Additionally, we thank Michelle Stoia from the Naval Health Research Center. We also thank the professionals from the US Army Medical Research and Materiel Command, especially those from the Military Operational Medicine Research Program, Fort Detrick, MD. We appreciate the support of the staff of the Henry M. Jackson Foundation for the Advancement of Military Medicine, Rockville, MD.

Human Participant Protection

This research has been conducted in compliance with all applicable federal regulations governing the protection of human subjects in research, and was approved by the institutional review board, Naval Health Research Center, San Diego, CA (Protocol NHRC.2000.007).

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REPORT DOCUMENTATION PAGE

1. Report Date (DD MM YY)	2. Report Type	3. DATES COVERED (from - to)
28-01-08	New	Mar 2007 – Jan 2008

4. TITLE AND SUBTITLE
A Prospective Study of Depression Following Combat Deployment in Support of the Wars in Iraq and Afghanistan

5a. Contract Number:
5b. Grant Number:
5c. Program Element:
5d. Project Number:
5e. Task Number:
5f. Work Unit Number: 60002

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8. PERFORMING ORGANIZATION REPORT NUMBER
Report 08-05

8. SPONSORING/MONITORING AGENCY NAMES(S) AND ADDRESS(ES)

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10. Sponsor/Monitor's Acronyms(s)
NMRC/NMSC

11. Sponsor/Monitor's Report Number(s)

12 DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution is unlimited.

13. SUPPLEMENTARY NOTES

14. ABSTRACT (maximum 200 words)

Background: Previous studies have reported an association between deployment and depression; however, these studies have been limited by small sample size or lack of longitudinal design.

Results: Deployed men and women with combat exposures had the highest onset of depression at follow-up (5.6% and 15.7%, respectively), followed by those not deployed (3.9% and 7.7%, respectively), and those deployed without combat exposures (2.3% and 5.1%, respectively). After adjusting for demographic, behavioral, and military characteristics, combat-deployed men and women were at increased odds for new-onset depression compared with nondeployed men and women. Conversely, deployed men and women without combat exposures were at decreased odds for new-onset depression compared with nondeployed men and women.

Conclusions: To our knowledge, this is the first large, longitudinal study to examine the relationship between deployment and depression. Deployment with combat exposures is a significant risk factor for new-onset depression among US service members.

14. SUBJECT TERMS
depression, questionnaires, military psychiatry, combat disorders

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	18a. NAME OF RESPONSIBLE PERSON
a. REPORT	b.ABSTRACT	b. THIS PAGE			Commanding Officer
UNCL	UNCL	UNCL	UNCL	10	18b. TELEPHONE NUMBER (INCLUDING AREA CODE) COMM/DSN: (619) 553-8429